GREEN ENGINE COOLANT (GEC):

CELLULOSE NANOCRYSTALS AS ENGINE COOLANT PROCESS

ITEX'18
29TH INTERNATIONAL INVENTION, INNOVATION & TECHNOLOGY EXHIBITION, MALAYSIA

Universiti Malaysia PAHANG
Engineering • Technology • Creativity

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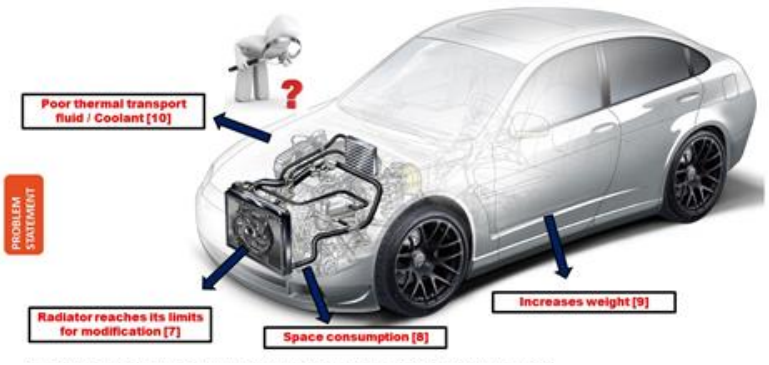
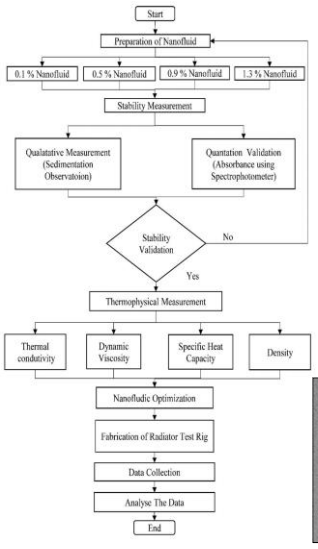
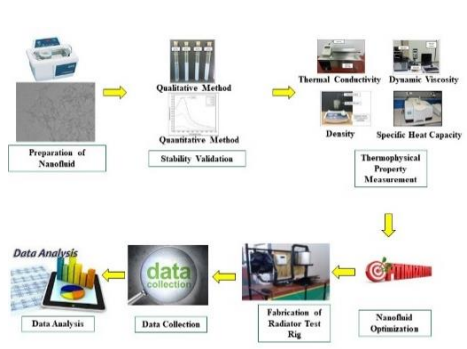
PRODUCT BACKGROUND

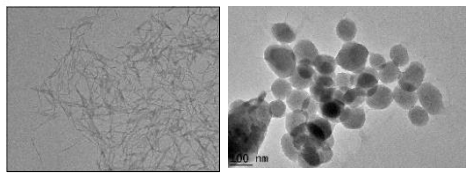
1. Today's Thermal Transport Fluid has low heat transfer capacity due to low thermal conductivity value
2. Cellulose Nanocrystal (CNC) is a green and renewable material which is composed of nano sized cellulose fibril with a high aspect ratio
3. Dispersion of nanosized material enhance thermal conductivity but provokes three critical problem; high sedimentation leads to poor stability, hazards to the environment and dangerous to human health



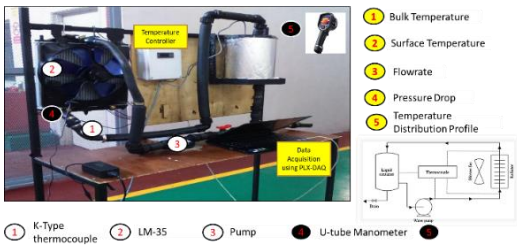
STATE OF ARTS /METHODS

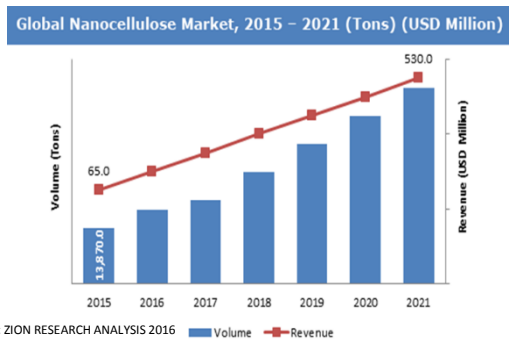






Micrographic evaluation of CNC under 120kV Bio-TEM

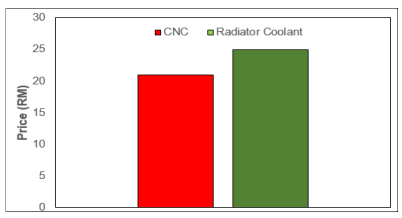




PATENT

PATENT FILLING STATUS: PENDING
DATED: 8/2/2018

BENEFITS/USEFULLNESS

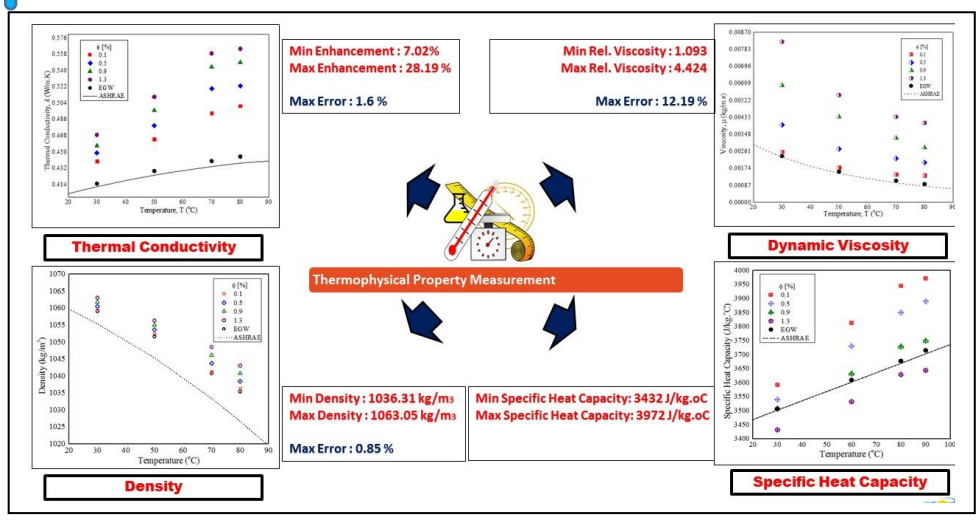


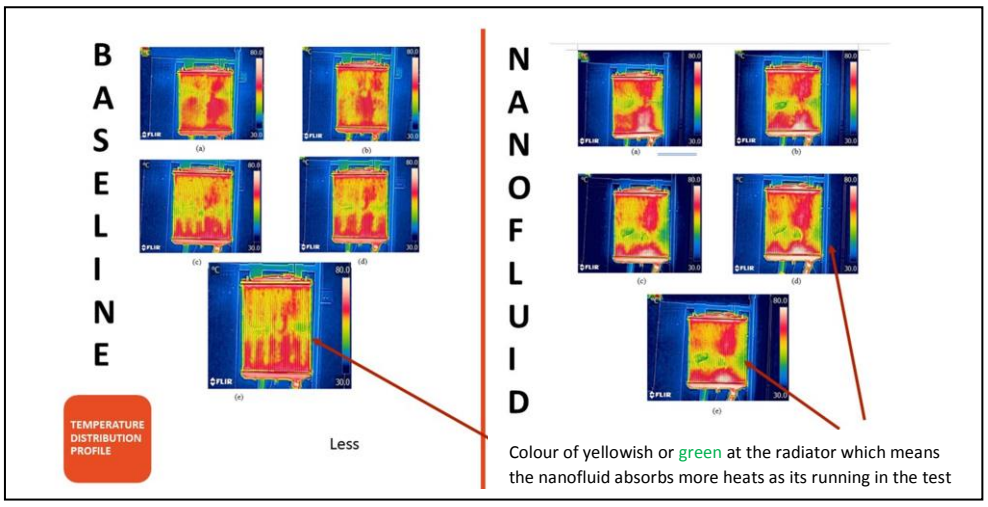
Cost Analysis for Green Engine Coolant (GEC)		
	Conventional	GEC
Average Mileage	48,000 KM	55,000 KM
Cost per Bottle – 500ml	RM 25	RM 21
Improved Mileage		7,000 KM
MILEAGE IMPROVEMENT		14.5 %
Actual Cost per Bottle		RM 28
COST REDUCTION		25 %

ENVIRONMENTAL IMPACT

1. The research is conducted to prove that addition of nanocellulose originating from plant base with varying concentration provides a better heat transfer efficiency. This environmental friendly material promises to reduce much hazards to human coolant applications.
2. The nanocellulose particle is between ranges of size 35-39 nm. The concentration is for of 0.1%, 0.5%, 0.9% and 1.3% particle additives. A statistical analysis shows that volume concentration 0.5% has an optimized thermophysical property from the design of experiments.
3. The experimental heat transfer coefficient, convective heat transfer, Reynolds number, Nusselt number has proportional relation with volumetric flow rate.
4. Thermal conductivity data it shows thermal conductivity increases from 0.487 W/m. °C at 30°C to 0.532 W/m. °C at 70°C while the viscosity decreases from 15.01 m.Pa.s at 30°C to 1.77 m.Pa.s at 70°C.
5. Thus, nanocellulose based nanofluid is suitable for automotive cooling application since it has a better heat transfer performance than conventional thermal transport fluid with environmental impacts.

PRODUCT CHARACTERISTICS





Colour of yellowish or green at the radiator which means the nanofluid absorbs more heats as its running in the test

PUBLICATIONS

1. **D.Ramasamy,** K. Ramachandran, K.Kadirgama, W.H.Wan Hamzah, "Cellulose Nanocrystal as A Dispersant in Nanofluidic Thermal Fluid: Investigation of Thermal conductivity and Viscosity Performance," International Communication of Heat and Mass Transfer, 2017 (IF = 2.559)
2. **D.Ramasamy,** K. Ramachandran, K.Kadirgama, W.H.Wan Hamzah, M.M.Rahman "State of Art on Principle Factors for Thermal Conductivity and Viscosity Enhancement in Ethylene Glycol-Water Mixture Base Fluid by Analytical Tool Approach," Renewable & Sustainable Energy Reviews, 2017 (IF = 6.798)
3. **D.Ramasamy,** K. Ramachandran, K.Kadirgama, W.H.Wan Hamzah, "Experimental and Correlation Model Determination for Thermal Conductivity and Viscosity of Cellulose Nanocrystal Dispersed in Ethylene Glycol and Water Mixture: Potential Heat Transfer Fluid for Energy Conservation and Management," Applied Thermal Engineering, 2017 (IF = 3.043)
4. **D.Ramasamy,** K. Ramachandran, K.Kadirgama, W.H.Wan Hamzah, "Investigation on Thermal Conductivity and Viscosity of Cellulose Nanocrystal as a Nanofluidic Thermal Transport through a Combined Experimental – Statistical Approach by using Response Surface Methodology," Applied Thermal Engineering, 2017 (IF = 3.043)
5. K. Ramachandran, K.Kadirgama, **D.Ramasamy,** "Cellulose nanocrystal as novel coolant for thermal transport applications: experimental investigation on thermal conductivity and viscosity", Proceedings of ICCHM 2017, Conference paper, 2017
6. **D.Ramasamy,** K. Ramachandran, K.Kadirgama, "Effective thermal conductivity and relative viscosity of cellulose nanocrystal dispersed in ethylene glycol-water mixture: combined experimental-correlation determination", Proceedings of ICCHM 2017, Conference paper, 2017

COLLABORATORS

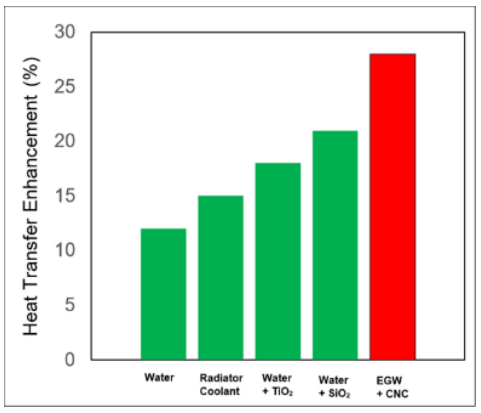
FOCUS APPLIED TECHNOLOGIES SDN BHD

NANOMALAYSIA

MARKETABILITY

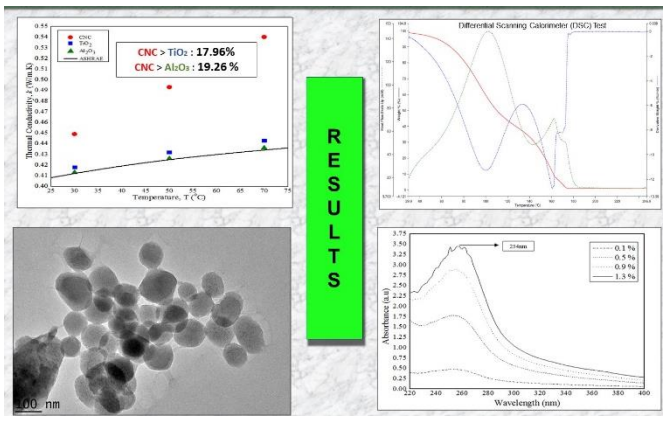
1. Small and Medium Manufacturing Industries
2. Automotive Components Manufacturing Industries
3. Aerospace Component Manufacturing Industries
4. Local Manufacturing Application Industries
5. Utilizing of nano-coolant and on cutting parameters in various machining processes.
6. Biomedical industry: Eco-nano-coolant for hard super-alloys

IMPROVEMENTS FROM CURRENT

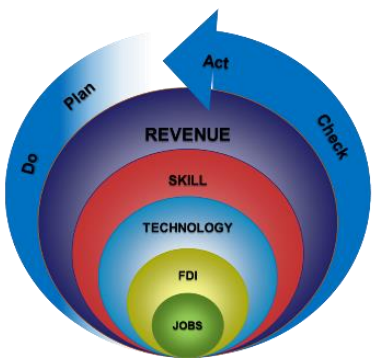


ACHIEVEMENTS

- **GOLD MEDAL,** CREATION, INNOVATION, TECHNOLOGY & RESEARCH EXPOSITION, 2018, UMP
- **SPECIAL AWARD,** AUTOMOTIVE ENGINEERING CENTER, 2018.
- **EXCELLENT AWARD** (JOURNAL PUBLICATION), UNIVERSITI MALAYSIA PAHANG, 2015, 2016, 2017 **MALAYSIA**



- Automobile Industries
- Green Environment
- Employment



To determine the best thermal conductivity, specific heat capacity and heat transfer coefficient using the NEWLY ENGINEERED COOLANT on a car radiator, **High thermal conductivity enhancement by 35%, Increases heat transfer capacity by 20% and environmentally friendly**